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PHASE COMPOSITION OF MICROSPHERES FOR PRODUCTION OF HEAT-INSULATING CORUNDUM CERAMICS

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The phase composition of hollow fused corundum microspheres is investigated. The problem of the presence of extraneous phases and their removal is discussed. The effect of heat treatment on the phase composition of the microspheres is studied.

The development of plasma technology has made it possible to obtain cast spherical particles (microspheres). Microspheres can be compact, porous, or hollow and have a polycrystalline, single-crystal, or amorphous structure. It is possible to develop ceramic materials with a preset structure and porosity and a narrow size distribution of the pores [1].

Ceramics of microspheres belong to the class of porous materials with a granular structure. However, such ceramic materials have a more regular shape and size of the structural elements than traditional materials with a granular structure. In using hollow microspheres, the overall porosity of articles can reach 80% [2 – 4].

The present study uses hollow fused corundum microspheres of grade T made at the NPO Stekloplastik JSC (TU 6-11-480–78) with a particle size of 40 – 200 μm and a bulk density of 0.36 g/cm^3. These microspheres are produced by melting the initial material in the form of rods or powder in a low-temperature plasma jet. The common processes for all methods of spheroidization include the melting of the material, formation of drops, and their solidification. Under the effect of surface-tension forces, the drops acquire a near-spherical shape, which is fixed in the course of cooling. The most regular spherical shape is achieved in small-sized particles (tens or hundreds of micrometers).

Spheroidization is usually performed using an arc plasma, which is the most effective. However, due to erosion of the electrodes in the arc plasma, the treated material is contaminated [5, 6], which leads to formation of additional phases in the resulting spheres. In this context, is necessary to analyze the phase composition of the microspheres and identify ways for removal of these phases or their transformation into α-Al_2O_3.

An x-ray phase analysis showed (Fig. 1) that the microspheres produced in the arc plasma exhibit peaks of the crystalline phase α-Al_2O_3 and peaks that can be attributed to γ-Al_2O_3.

These phases can be present in the microspheres, since heating and cooling in the course of microsphere production occur rapidly under nonequilibrium conditions. As a result, γ-Al_2O_3 does not have time to convert fully to the α-form. Aluminum may also react with atmospheric nitrogen, thus producing aluminum oxynitride AlON.

A comparative analysis established the presence of several polymorphous modifications of aluminum oxide. The assumption of the presence of aluminum oxynitride in the microspheres was not corroborated.

The phase composition of the hollow corundum microspheres was studied after heat treatment at 1630°C. The experimental results are shown in Fig. 2. As can be seen, only α-Al_2O_3 peaks are observed.

The problem of the presence of heterogeneous phases and incompleteness of the crystallization process, which are determined at the stage of microsphere production, is elimi-

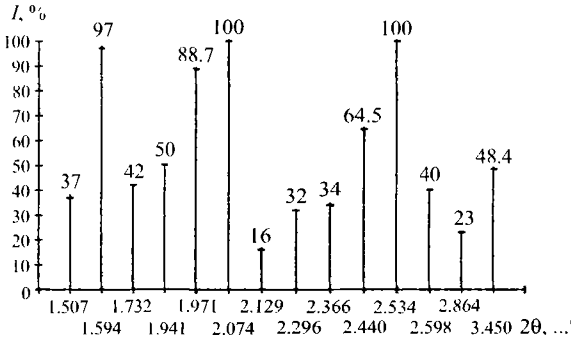

Fig. 1. X-ray phase analysis of hollow corundum microspheres.

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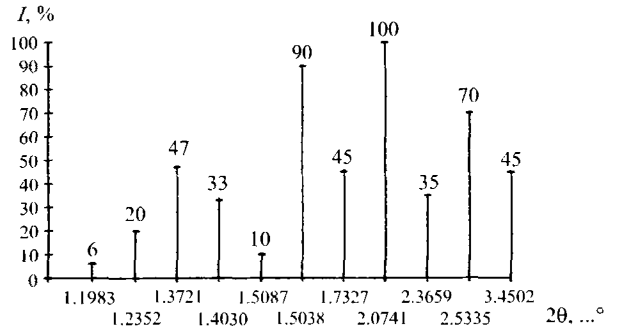

Fig. 2. X-ray phase analysis of the microspheres after heat treatment at 1630°C.

nated in the case of heat treatment of the microspheres or the article consisting of these microspheres, which means that no additional heat-treatment stage will be needed in the production of ceramics.

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